across to the catalog, such as references to the biology or the distribution of the ants, even if it would have been only the name of the country. This would have expanded the book substantially, but who else gets the chance (and the personality) to do such a compilation again? Also, there is no index to the species and other taxa, and electronic publication and dissemination of the catalog as such, or as database are not available. One might argue that Barry Bolton and Harvard University Press sell the catalog at a (too) high price for a developing nation's scientist. I would have preferred this kind of information available on the Internet, especially because the whole catalog was paid for by the taxpayer anyway. No matter, for it is Barry Bolton who made the catalog, and he merits the highest recognition for it.

I am sure, that the age of the ants has finally been launched by this oeuvre. For the first time, ants will really be available for biodiversity and conservation studies: ants the rulers of global biodiversity, wrangled by the king of the ants, and explained by the lord of the ants, Ed Wilson.—*Donat Agosti, Dept. of Entomology, American Museum of Natural History, Central Park West at 79th St., New York, New York 10024.*

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The Tent Caterpillars.—Terrence D. Fitzgerald. 1995. Cornell University Press, Ithaca and London. 338 pages, 8 color photographs, 38 black and white photographs, 101 drawings. $37.95 (cloth).

Consider the various aspects of lepidopteran biology that have drawn the fascination of scientists and layman alike: The sheer diversity of the group; its incredible array of life histories and hostplant associations; coevolutionary curiosities such as mimicry complexes; and, of course, their often charismatically showy coloration. Moth larvae have also been responsible for some of the most costly challenges facing foresters, farmers, orchardists, and horticulturalists. Indeed, the Lepidoptera are perhaps unique in having captured simultaneously the fancy of poets and the wrath of would-be pest control efforts. In this volume, the latest in the Cornell series in Arthropod Biology and the last to be edited by the late George C. Eickwort, T. D. Fitzgerald synthesizes a vast literature devoted to the biology of tent caterpillars

(*Malacosoma* spp.) from ecological, evolutionary, behavioral, physiological and applied perspectives. In summarizing over 400 references as well as his own impressive research program devoted to the North American tent caterpillars, the author seeks to draw together information for one of the few lepidopteran groups better known for the biology of their caterpillars than as adult moths; caterpillars that, in the author's words, "sit at the pinnacle of caterpillar social evolution" (p. 27).

"The Tent Caterpillars" begins with a brief review of the life history and taxonomy of *Malacosoma* (Chapters 1 and 2). The bulk of Chapter 2 comprises an articulate, highly speculative, but nonetheless intriguing discussion of the possible factors mediating the evolution of tent caterpillar communal behavior, a discussion that resurfaces throughout the book, and to which I shall return below. Chapters 3 and 4 cover the anatomical and physiological features of larvae and pupae (Chapter 3) and of adults and egg masses (Chapter 4). The next four chapters skip from the ecology of caterpillar-hostplant interactions (Chapter 5), to the behavioral ecology of larval aggregation and foraging (Chapter 6), tent building (Chapter 7); and, finally, to interactions with predators (Chapter 8). Chapters 9 and 10 cover the ecology of tent caterpillar outbreaks, their economic impact and management, and Chapter 11 concludes the book with a how-to section devoted to classroom and laboratory experiments with maintained colonies.

One of this book's highlights is the review of larval biology in Chapter 3. The numerous figures in this (and the subsequent) chapter, including SEM's, figures of anatomical systems (mostly redrawn), and photographs, are well-labelled, referenced, and explained to the extent that this section could well serve as an excellent general primer on lepidopteran larval morphology and biology. While I was already familiar with much of the ecological and empirical work on *Malacosoma* discussed in later chapters, I was very impressed with the range of basic anatomical and physiological studies that have been conducted on *Malacosoma* caterpillars. I was fascinated, for example, to learn that test caterpillar larvae are the only immature insects known to exhibit Tyndall colors, and the only insects in which the Tyndall effects are cuticle-derived (p. 48).

From the outset, the author emphasizes one of the most fascinating aspects of larval *Malacosoma*: their communal behavior. As he notes, there are few other caterpillars exhibiting the complex communal behavior of *Malacosoma,* and none whose overall biology has been so extensively studied. Throughout, Fitzgerald presents fascinating accounts and exhaustive syntheses of an immense number of published studies, many of which he co-authored. Most of these works have been strictly ecological in nature. Although Fitzgerald devotes substantial attention to the evolution of social behavior (most often citing E. O. Wilson's seminal texts on insect societies (1971) and sociobiology (1975)), much of his discussion is undercut by an avoidance of a phylogenetic perspective. If I have one general criticism of the book, it is that much of Fitzgerald's numerous evolutionary discussions could have been enhanced by a more macroevolutionary bent. While Fitzgerald appears to pay lip service to phylogenetic systematics, his treatment of both taxonomy and evolutionary scenario-testing suffer from a poorly articulated phylogenetic platform; and to the extent that the systematics of *Malacosoma* specifically, and lasiocampids in general, are covered at all, they are given rather short shrift in terms of the context they will no doubt provide in future studies of the evolution of tent caterpillar sociality. The

reader is referred to the taxonomic revisions of Franclemont (1973) and Stehr and Cook (1968), and summaries of alpha-taxonomic revisions of those authors are presented early on in Chapter 2. Granted, as with most lepidopteran groups, the systematics of lasiocampids have not been recently worked, and reproductions of color plates representing various *Malacosoma* adults and larvae may have seemed redundant to the author given their coverage in the Moths of North America fascicle. However, the four pages or so of text devoted to *Malacosoma* taxonomy, the tabular summary of valid trinominals on pages 8–10, the single paragraph devoted to "phylogenetic considerations" immediately thereafter, leave the impression of dispensing with systematics as quickly as possible so as to proceed to other, perhaps better studied aspects of ten caterpillar biology. Given that the book includes several color plates depicting larval aggregations, tents, and predation by a vespid, one wonders why the effort was not made at least to figure the six North American species of *Malacosoma.*

The avoidance of systematics detracts from the author's discussions of the evolution of social behavior as well. Although, again, lasiocampid systematics are clearly not well enough resolved to support macroevolutionary scenario-testing, some discussion of the potential for such work is warranted. A growing body of literature suggests that the evolution of sociality can and should be addressed phylogenetically, and that various behavioral attributes of organisms may be phylogenetically conservative. The author does make note of Sillén-Tullberg's early work (Sillén-Tullberg and Bryant, 1983) on the role of natural selection in the evolution of aposematism (p. 203), but not her more recent (and controversial) discussions of the utility of phylogenetics in addressing the evolution of gregarious behavior and aposematism in butterflies (Sillén-Tullberg, 1988) and in tree-feeding moths (Sillén-Tullberg and Hunter, 1996). Neither Carpenter's (1989) application of phylogenetics to the evolution of sociality in vespid wasps, nor the potential for coding behavioral characters such as those associated with nest-building are mentioned. Generally, Fitzgerald ably summarizes various views on the evolution of sociality, but rarely if ever critiques or explains the limitations of the kinds of data used in support of those views (but see p. 136).

Relatedly, I found Fitzgerald's recourse to natural selection as the primary agent mediating the distribution of various tent caterpillar life history parameters somewhat trite. The author often glibly invokes natural selection and adaptation to explain cluster oviposition (p. 80), the timing of larval eclosion (p. 93), synchronous foraging (p. 144), tent architecture (p. 148), and the evolution of warning coloration (p. 203) with little or no discussion of the potential for phylogenetic information to illuminate the various hypotheses and speculations. While the author devotes considerable text to describing the phenology of larval eclosion and feeding, and the climatic and ecological forces presumed to have selected for those phenologies, no direct mention is made of Feeny's phenological window hypothesis, nor, again, of the possibility of phylogenetically conservative seasonal histories.

For the most part, The Tent Caterpillars succeeds in covering a great deal of ground. As with any work dedicated to the holobiology of any organism(s), it is necessary to present a fair amount of background information, if only as context from within which to highlight the uniqueness of the organisms in question. In the chapters devoted to the ecology of herbivore-hostplant interactions and of outbreak

species such as *Malacosoma,* Fitzgerald switches adeptly from general discussions providing background on the nutritional ecology and hostplant chemistry to the specific mechanics of tent caterpillar feeding biology. Fitzgerald provides an able review of the various quantities typically used in nutritional ecology studies (pp. 95–96), and a superb synthesis and critique of the literature devoted to the nutritional ecology of *Malacosoma* in particular. Perhaps more background information might have better highlighted some of the interesting aspects of the biology of *Malacosoma* and of outbreak species generally. Fitzgerald does cite Nothnagle and Schultz (1987), who cataloged life history parameters common to many outbreak species, but again much of the discussion devoted to the ecology of *Malacosoma* outbreaks relies heavily on speculations based on the "ghost of natural selection past." Such discussions might well have been enhanced by emphasizing, for example, that many of the more notorious outbreak pests belong to families of moths that do not feed as adults. By the same token, Fitzgerald's discussion of nutritional ecology would be enhanced by a more rigorous discussion of the relevance of generalist/specialist evolutionary ecology, for example by referencing some of the more recent literature devoted to the evolution of hostplant specialization.

That notwithstanding, this text is, overall, extremely well-referenced with roughly 450 citations, more than a third of which are published since 1993, and almost two thirds since 1980. Quotations provided from such early American entomologists as T. W. Harris are of historical as well as biological interest (Harris's bizarre quote on p. 234 comparing the extermination of larvae to that of Florida Indians notwithstanding). I was delighted to read that my father's habit of torching *Malacosoma* tents with kerosene-soaked rags was a not-unusual, but uniquely American tradition (pp. 236–237). Both historically and scientifically, Fitzgerald's account of applied entomological research as regarding tent caterpillars is thorough—down to the mechanistic descriptions of biological control agents—and makes for fascinating reading.

Although I found the presentation of evolutionary life history scenarios somewhat deficient, I recommend this data-rich book for its breadth of coverage and as an intriguing synthesis of the biology of a fascinating and oft-overlooked group of organisms. Fitzgerald has clearly inspired a generation of tent caterpillar researchers and afficionados, and both his skills and those of his former students in field- and laboratory-based experimental design are evident from the impressive contribution of data summarized in this text. The final chapter will no doubt prompt numerous classroom studies, and may well add to Fitzgerald's apparent legacy of enthusiastic protogés.—*Paul Z. Goldstein, Dept. of Entomology, American Museum of Natural History, Central Park West at 79th St., New York, New York 10024.*

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